Guide

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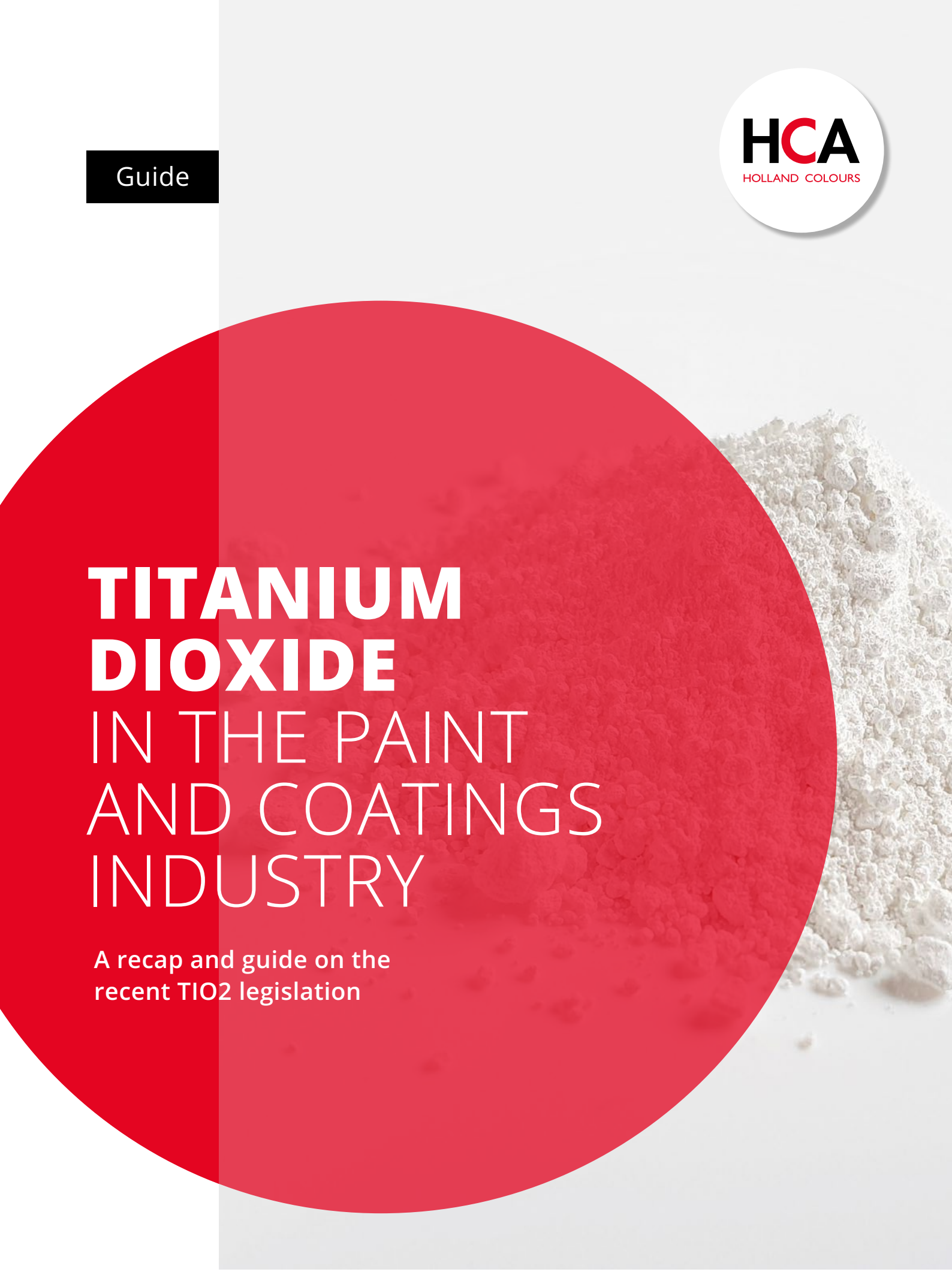

TITANIUM DIOXIDE IN THE PAINT AND COATINGS INDUSTRY

A recap and guide on the recent TIO2 legislation

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TABLE OF CONTENT

WHAT IS TIO2 AND WHAT ROLE DOES IT PLAY IN THE COATINGS INDUSTRY

Titanium dioxide is a white pigment most commonly used in the coatings and paint manufacturing world. It is used in all kind of products and applications (cosmetics, paper, coatings, food, plastics, etc.) and the largest usage of TiO2 occurs in the paint and coatings industry. Around two-thirds of all pigments in the world use TiO2 for its unrivalled qualities.

The white and opaque pigment is currently the most effective method available for scattering visible light in paint and coatings because of its high refractive index. This provides an effective way of inducing whiteness (because the white powder does not absorb light), opacity and a certain degree of brightness to paint and coatings. Its hiding power is the major factor in the widespread use of TiO2. TiO2 occurs in several crystalline structures, but in practice, rutile and anatase are the most widely used.

Commercially, the pigment is available in various different qualities in particle size, shapes and post-treatments which can all have an effect of various aspects of the final product (scattering efficiency, dispersion, milling time, opacity and hiding power, etc.).

What is TIO2?

Beyond the processing of the pigment, it is subjected to additional processing for specific use cases. Additives or additional processes are used to, for example, enhance its dispersion. These different processes and their effects, combined with the size of the pigment particle influence the color of the TIO2 products.

IMPORTANT FACTORS IN SCATTERING EFFICIENCY

Obviously, particle size plays a major role in providing maximum efficiency with regards to scattering but another aspect that is sometimes overlooked with regards to TiO2, is the pigment volume concentration. In TIO2, it is important to obtain the right degree of separation between the particles for the scattering to be as effective as possible. The higher the Pigment volume concentration, the less space there is which reduces the distance, which may after a point, reduce the efficacy for scattering. **This is especially important when the % of TiO2 used is high as in paints and coatings.**

For maximum efficiency with regards to scattering it is vital that the degree of separation is optimal, and that the particles themselves are dispersed equally and appropriately. This means that PVC beyond the correct threshold, which for TIO2 is no more than 30%, equates diminished effectiveness with regards to opacity and color strength.
There are many other factors that could affect the final end quality of the formulation:

- Fineness of the grind
- Milling process and equipment
- Particle size and shape
- Storage methodology

CAVEATS

There are 2 caveats when it comes to TiO2: there are issues with agglomeration, which require significant tweaking (and can affect QA efforts) as well as new health and safety regulations. We'll provide a quick overview of the agglomeration issue, because at its core, it has overlap with some of the new regulations (especially with regards to particle size).

AGGLOMERATION

A major issue when it comes to working with TiO2, or with any other pigment powder particle, is agglomeration. The degree of powder agglomeration in a suspension, can have a significant effect on the final quality of the end formulation.

Many issues can arise as a result of this problem. For example it can cause a substandard degree of dispersion of particles or sedimentation. Excellent dispersion efficiency is required to ensure the formulation reaches the standards required.

Because these issues cannot be left untreated, it requires careful adjustments to the formula. In order to prevent agglomeration, different strategies are used e.g. using dispersant additives / adjusting the size or shape of the particles / fineness of the grind.

HEALTH AND SAFETY REGULATIONS

Titanium Dioxide has recently been the subject of significant controversy and new (and developing) regulations. Research on rats showed that there is a potential cancer risk for rats that are exposed to very high quantities of titanium dioxide by inhalation, a process referred to as "excessive lung overload". According to TDMA, there were several caveats related to this research:

"The extreme doses used in scientific studies with rats do not reflect normal conditions of use or exposure, and there is no evidence of potential cancer risk to workers who may be exposed to TiO2 on a daily basis. "This classification applies to a subset of powder forms and it was published on the 18th of February 2020, and went into effect in October 2021 after a transitional period of 18 months.

SO WHAT DOES THIS REGULATION MEAN?

The EU uses a frame work called the CLP, *classification, labelling and packaging of substances and mixtures (CLP Regulation)*, to create a standard method of providing packages with labels that add information about the possible risks involved when it comes to the packaged chemicals. An important caveat is that this classification does not take into account likelihood of potential meaningful exposure (meaning, how realistic is it that this actual chemical would be ingested in dangerous quantities or methods).

According to the EU regulations, this issue the potential risks will arise if TiO2 powder, for example in dust form, is inhaled by humans in large concentrations. This could cause serious lung impairment. It is important to note that European Chemicals Agency (ECHA) has mentioned that "the suspected hazard described for TiO2 is not specific to the substance but common to all dusts/powders known as 'poorly soluble low-toxicity substances'.

HOW DOES THIS AFFECT TIO2 PROCESSING

The classification mentions the following:

> *The substance TiO2 must be classified as carcinogen if inhaled (Carc. 2, H351 (inhalation) when supplied on its own or in mixtures, where the substance or mixture contains 1 % or more of TiO2 particles with an aerodynamic diameter ≤10 µm.*

So if you supply TiO2, either as a pigment powder or as part of a mixture that contains at least 1% of TiO2 particles with an aerodynamic diameter ≤10 µm, you fall within that scope and must therefore classify your product as carcinogenic Category 2.

> *"In addition, **mixtures** containing TiO2 must be labelled with the supplemental label element 'Hazardous respirable dust may be formed when used. Do not breathe dust' (EUH212). "*

Any mixture containing TiO2, must be labelled appropriately.

> *"**Non-classified solid mixtures** must also be labelled with the EUH212 supplemental labelling element if they contain at least 1 % of TiO2, regardless of their form, or particle size."*

For non-classified solid mixture, the labelling requirement is the same, meaning it must be labelled regardless of the shape or aerodynamic diameter of the TiO2 particle.

> *"Liquid mixtures containing TiO2 do not require Carc. 2 classification. However, if they contain at least 1 % of TiO2 particles with an aerodynamic diameter ≤10 µm, then they need to be labelled with the supplemental label element 'Hazardous respirable droplets may be formed when sprayed. Do not breathe spray or mist' (EUH211)."*

This is self-explanatory: liquid mixtures have a slightly different approach, and do not require the classification, but still require the appropriate labelling if the TiO2 Particle falls within the aerodynamic diameter threshold. For a full guide on the specifics of classification and labelling of titanium dioxide, please see the ECHA guide here.

Health and safety

WHAT DOES THIS MEAN **FOR PRODUCERS WHO WORK WITH TIO2**?

Because this issue is mostly relevant for producers (end product users do not have to use or be exposed to large quantities of TiO2 powder which means that this issue does not relate to end products) it is, for all intents and purposes, a workplace hazard issue. This is why most of the measurements taken are with regards to safe usage:

- Proper ventilation systems such as Local Exhaust ventilation
- Ensure adequate and plentiful usage and availability of PPE (personal protective equipment)
- General measures to reduce dust formation.

Jules Roelofs,
PhD Global Innovation Manager at Holland Colours

"The most difficult part of the new regulations around TiO2 was the lack of clarity. What do the legislations mean in concrete terms? We put in a lot of effort to make this as clear as possible with all the info from our suppliers and other interest groups. At the time, no one was able to give clear answers and directions. So we decided to take measures into our own hands and actively research and pursue this ourselves. We setup a TiO2 taskforce to investigate this. And when it became clearer, we wanted to know how to quantify it?"

DOES TIO2 POSE SAFETY RISKS FOR OPERATORS AND WORKERS?

According to the available research, workers who are active in TiO2 manufacturing do not have cause for concern in regards to exposure. Whenever standard health and safety requirements are followed properly, we have not seen any detrimental effects on worker health that can be linked to TiO2.

UNCERTAINTIES

According to the TDMA, the Titanium Dioxide Manufacturers Association, a major issue in the regulatory text is that several terms and definitions are present without adequate frameworks to judge them by, which only creates more doubt and uncertainty. Currently, several parties are actively trying to parse this text and if you are interested, please sign up to our information newsletter to be informed of new updates.

HOW WILL THIS AFFECT PAINT AND COATINGS MANUFACTURERS?

In situations where TiO2 is suspended, such as paint (where the particles have been finely dispersed in a liquid), there's good news. According the new laws and regulations, these mixtures do not need to be classified as carcinogenic, but they do need to be labelled correctly. The correct label for this mixture would be with EUH211, but only if it falls within the following parameters:

"The suspension is formulated with titanium dioxide and contains at least 1 % of TiO2 particles with aerodynamic diameter ≤ 10 µm, and this means that the proportion of titanium dioxide particles with aerodynamic diameter ≤ 10 µm used represents at least 1 % of the total mass of the suspension."

↓ %

CHECKLISTS

In order to provide producers with a useful file that helps them to create a workplace that is safe, efficient and effective, we've provided a small checklist. This has the most important elements that can help you ascertain whether or not you've taken the right steps. This file has been adapted from the TDMA, to include inspiration from our own processes and how our own operators have worked with.

The general, overarching guidelines are:

- Ensure the presence of a proper, functioning and adequate ventilation system.
- Create a standardized working method where your ventilation system is always turned on before starting the processing.
- Have a proper schedule of maintenance and inspection for your ventilation system, PPE and other dust reduction aspects.
- Ensure proper plant hygiene: use a vacuum and / or wet cleaning methods to ensure there are no spills or other unhygienic build ups anywhere
- Ensure personal protective equipment hygiene: ensure single use items are disposed of after every usage, and there are adequate replacements within reach to make it easier for your personell to follow protocols without losing time.
- Make sure only qualified and authorized personnel have access to the areas in which TiO2 is being processed.

FOR A MORE DETAILED SET OF GUIDELINES, PLEASE REFER TO THE LISTS HERE.

Arnold de Groot,
Plant Manager,
Holland Colours

"The biggest challenge with regards to the TiO2 regulations in the context of my role as a plant manager, was the storage issue. Would that pose a problem? Would we have to change our setup? We prepared different scenarios and researched all the different options and avenues. Luckily, we found that our TiO2 did not have to qualified as a potentially dangerous substance due to its size and method of processing."

BAG EMPTYING

FULL CREDIT GOES TO THE TDMA FOR CREATING THE CHECKLISTS

PLEASE REFER TO THE FULL CHECKLISTS HERE.

Access

- Restrict access to the work area to authorised personnel only.

Design and equipment

- Ensure bag emptying equipment is fit for purpose.
- Enclose the bag emptying equipment as much as possible and keep it under negative pressure by using a local exhaust ventilation system.
- The hood's exhaust volume requirement is a function of the open hood area, with experience showing that air velocities of 1 m/s (200 fpm) into the hood are adequate for DE dust capture.
- For small bags, the use of automatic or semi-automatic bag dumping stations is recommended for emptying the bags.
- Ensure workers tip the bag contents progressively – never dump them.
- Provide a clean air supply to the workroom to replace extracted air.

Patrick Bos,
HSE Manager &
Prevention Officer

Our stations also use these same methods, broadly speaking. We also employ local exhaust ventilation in the different areas. However, in our plants we don't utilize "automatic or semi-automatic bag dumping stations".

BAG EMPTYING – BULK BAGS

FULL CREDIT GOES TO TDMA FOR THE CHECKLIST.

CLICK HERE TO DOWNLOAD A CHECKLIST FOR ALL EMPLOYEES

Access

- Restrict access to the work area to authorised personnel only.

Design and equipment

- Ensure bag emptying equipment is fit for purpose.
- Enclose the bag emptying equipment as much as possible and keep it under negative pressure by using a local exhaust ventilation system.
- For single trip bulk bags without inner liner, use bag emptying equipment featuring pyramidal cutting knives and a rubber membrane to seal off the bag bottom. Manual bag cutting is not recommended without the use of personal protective equipment.
- For multiple trip bulk bags, a discharge system with vibrator plate may be used and this could be equipped with local exhaust ventilation.
- In order to dispose of empty bags without creating dust, do not manually compress the empty bags. Instead, drop them into a large plastic sack supported and held open by a metal frame. When it is full, seal the sack and dispose of it in a suitable waste skip. DO NOT let the waste sack overflow.
- Bag emptying equipment may be connected to a suitable dust arrestment system (e.g. bag filter/cyclone) and may be easy to access for maintenance, unblocking and cleaning.
- Where possible keep bag emptying equipment away from doors, windows and walkways to prevent draughts affecting the performance of dust extraction systems.
- Provide a clean air supply to the workroom to replace extracted air.

Maintenance

- Ensure equipment used in the task is maintained, as advised by the supplier/installer, in efficient working order and in good repair.
- Replace consumables (filters etc.) in accordance with the manufacturer's recommendations.

Examination and testing

- Visually check PPE daily for signs of damage. If used infrequently, then check it before each use.
- Check effectiveness of dust suppression and/or extraction equipment before use. Seek advice from the supplier and keep relevant records to compare in future tests.
- Keep records of inspections for a suitable period of time to comply with national laws (minimum five years).

Cleaning and housekeeping

- Clean your workplace on a regular basis and clean spills immediately. Do not clean up with a dry brush or using compressed air.
- Use water or vacuum cleaner fitted with a HEPA filter to remove dusts and powders during cleaning.

Carry out maintenance and repair work only at facilities that are not in operation. Minor cleaning tasks may be conducted when facilities are operating, if it is safe to do so.

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